User Tests

What kind of UI has the best usability and what is the most intuitive way of controlling it with an AR-wearable?

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Introduction

To answer the sub-question “What kind of UI has the best usability and what is the most intuitive way of controlling it with an AR wearable?”, 5 rounds of user tests were completed. The goal of these tests was to try out multiple ways of menu placement and control with the Magic Leap. Out of these tests was concluded that multiple kinds of menus could be used for different purposes. These conclusions were, however, made for the use of the Magic Leap. Other AR wearables could have different guidelines for UI placement.

During tests, it was also tested if physical strains were experienced during tests. Out of test came that to really test this, the wearer needed to use the Magic Leap for a time longer than 15 minutes.

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User test round 1 results

Introduction

In total, 8 tests were conducted during the first usertest round. In this document, all the results are written down. Out of this, a conclusion will come. After this, the recommendations will be written.

Outcome tests

Questionnaire 1:

Out of 8 test persons, 2 have used the Magic Leap before. These 2 haven’t used it intensively before.

Test persons knowledge of AR varies. Most of them have a basic knowledge of what AR is, some have more advanced knowledge.

Test 1:

1.

liked to use the controller.

Got scared as the sounds pop (need more visual guidance)

Button mapping not clear

First button pressed -> home button

used the controller with 2 hands.

2.

Riddle 3 opened by accident

Riddle 1 was easy

The sign wasn’t intuitive on how to use it -> Tried to draw the sign with the controller.

Touch was intuitive.

3.

Not good at riddles

1st interaction was easy

Really liked the gesture

Comfortable with the eye tracking

4.

Controller worked well, testperson picked it up and felt comfortable.

Gesture was a bit hard to use, didn’t understand that she needed to look at it to activate it.

5.

Picking up controller number one, went well.

Amazed by sign working

Use eye signs for number 3, still activated because he was looking at it.

pressing is ok.

6.

First thing he did was picking up the controller

1st riddle was easy

amazed by gesture capability

3rd was easy/natural for him

7.

Riddle box was clear

8.

instantly got gesture one

knew the gesture but not how to use it

thought it was a gesture

Easy.

Test 2

1.

Rotating with the controller is hard (too low sensitivity)

General manipulation with the controller is not intuitive.

Knowing which buttons for right combination is hard.

hard time selecting the object by hand.

distant manipulation with hand not clear.

moving with hands was fine.

scaling not intuitive with both devices. (hand wrong axis to scale.)

2.

Pressing the object was hard with hands.

After figuring out how to hold the object, the manipulation were easy to understand.

Button mapping on controller not clear.

Button combination is hard to keep track of, too much information needed.

Likes the hands more, but controller is easier to use at the moment.

Tried to grab the object same way as in real life.

Buttons are in the way of the object.

3.

Grabbing and moving object with controller is easy.

Rotating not comfortable, too low sensitivity

depth moving not easy.

Selecting object with hands is hard.

Lost tracking of object, object had snapped out of FOV.

comfortable with controls.

4.

use of controller went naturally, when teached the controls, it went well.

Hand were harder to use, buttons were in the way.

5.

Was hard to select object with hands, because of the bubbles.

Hand got out of FOV many times.

Learning controls with controller is pretty hard

rotate sensitivity is too low with controller.

6.

Fast selecting the object and manipulate it

The bubbles are in the way

Hard time locking with the controller because of bubbles still in the way.

Easy movement with the controller

Rotating was hard to trigger

Scaling and rotating with controller are not intuitive.

8.

Tried opening the teapot with the hand

used the controller to manipulate it instantly

hard time selecting the bubbles, figuring out how it works

not clear what to do or interact -> need clearer user journey to test.

Questionnaire 2- General thoughts

What were you feeling when the first level started up?

It was cool visually.

Cool first impression

It was cool, although weird (she could see something we couldn't)

weird and cool

Searching for object.

Futuristic and cool to integrate 3d objects in the environment.

It is weird needing to move to interact with objects, because we are used to using screens.

Seeing thing around other people cant see.

Was it clear how to manipulate objects in AR?

Not at first, but after learning it went pretty smooth

Pretty easy

After understanding the basics it went pretty easily

controller was easier, hands were cooler

Hand controls were more liked, more obvious.

The hands feel more natural, controller button mapping is hard.

Riddle box is clear, but the object manipulation isnt as intuitive without guidance.

Instead of buttons, use tools to represent the action.

Uncomfortable?

eye strains

heavy

sound needs to get blended in better.

Conclusion

The riddle box was positively received by the audience. The test persons were amazed by the capabilities of the Magic Leap, the gestures were liked very much.

The manipulation of the object with the controller is hard to learn but when teached it goes well. Rotation with controller is hard, because the rotation is the same as the rotation of the controller. This makes turning something 180 degrees nearly impossible.

The manipulation of the object with hands is generally more intuitive according to the testers. The first thing people tend to do is trying to grab the object, the same as in real life. However, the selection of the object is to difficult and the manipulation bubbles are in the way of the object itself. Because of FOV limitations, the hands get out of the screen to many times, which results in the snapping of the object.

Recommendations

To make the manipulation of the object easier, the control buttons need to change position to a point that is on the user (like on the arm).

The touching of the object needs to be optimized, like with the touch of the control buttons

Tools could be thought of to manipulate the object, like having a magnifying glass for scaling.

Think of a way to combinate the controller with the hands, they both have their strengths and weaknesses.

Rotating needs to be redone, both ways were not intuitive.

User test round 2 results

Introduction

In total, the test was conducted on 5 users. These users were different than the ones who tested the prototype 1.

First, all answers and notes will be written down, after that a conclusion will be made with recommendations.

Outcome tests

Questionnaire 1

All users were first time Magic Leap users. They have, however, worn a VR device before.

User test – Recreate the scene

Test person 1:

- Selecting the “room” button was pretty straightforward.
- Assumed to use the controller to select “new room” instead of using hands
- Popped the bubbles with his finger
- Hard to understand how to move objects in depth
- When told to grab, user instantly used hand instead of controller
- Anchoring objects before manipulation is hard
- The urge to grab objects with hands is always present
- After learning the controls, user gets exponentially faster at object manipulation
- Rotating y-axis is hard

Test person 2:

- Liked arm mounted menu, really cool
- Finger box is distracting
- Tried to select “new room” with controller
- Tried to grab objects with hand
- After controls are explained, user manipulates objects pretty fast
- User feels that it works pretty well
- Anchoring objects is hard, when rotation is needed
- Not entirely clear how objects are spawned
- Worked around the object anchoring by knowing the object was left of him
- Selecting overlapping objects is hard

Test person 3:

- Liked arm mounted menu
- Difficult to know when to use hand or controller
- Anchor things is hard to learn
- After learning the controls things got faster and more intuitive
- Not enough feedback for the user to know what is happening
- Sometimes used the controller with 2 hands

Test person 4:

- Good reaction on using left hand to press the menu
- Easily got through the menus
- The urge to touch objects with left hand was present
- Not clear when to use controller and when to use hands
- Double pressed the arm menu buttons
- Learned the controls pretty easy
- Gets tired of using arm mounted menu for little things

Test person 5:

- Not clear when to use controller or hands
- Not clear when things spawn
- After figuring out the controls, things go smoothly
- Not enough feedback on objects selected and deselected
- Sometimes used the controller with 2 hands
- Not clear how to move objects in depth with the controller, usually moved the arm to do that
- Person managed to do the task while talking about other things (multitasking)

Questionnaire 2 – General thoughts

What were you feeling when you first started up?

- Small field of view compared to VR
- Confusion with laser or hands
- Getting used to how it works, it became easier after.
- Getting used quite easily
- Felt like normal

Was it clear how to get through the menus to create a new scene?

- Reasonably
- Did not know when to use what
- It is easy when you get the hang of it
- Quite intuitive after you get the hang of it
- Would be easier to just skip the pedestal

What is your vision on the arm mounted menu?

- To many times to switch between objects, use it as a menu
- Very cool
- Nice, could be a bit more subtle
- Really nice, selection is sometimes a bit awkward
- Good idea

Was it easy to recreate the scene?

- Yes, after learning the controls
- Selection was hard for small objects next to big objects.
- When you get the hang of it
- Yes
- Yes, within five minutes controls were easy.

Conclusion

The arm mounted menu was generally positively received. For some users it had to be used a bit too many times, but it was not annoying. The users had the feeling they were augmented when seeing the menu pop up when turning their arm.

To get to the creation scene was hard because there was no indication on when to use what kind of interaction (controller or hands). The user also had to go through to many menus to get where they wanted to be. Also the menu on the table was in the way of the object placement.

The object manipulation was a great improvement when looking at the prototype before. After people were learned the controls, it became quite easy to recreate a scene.

Recommendations

Put most functions into one, easy to reach, menu instead of multiple menus.

Disable the hitbox visualizer, it distracts the user

There must be a clear definition on when to use what means of controls. Do not use them next to each other

The user needs more visual feedback when interacting (let laser become green when objects is grabbed etc.)

User tests round 3 results

Introduction

In total, the test was conducted on 5 users. These users were different than the ones who tested the prototype 2 but some are the same as users who tested prototype 1.

First, all answers and notes will be written down, after that a conclusion will be made with recommendations.

Outcome tests

User test – Recreate the scene

Test person 1:

- Didn't understand that shelves could be scrolled
- Thought the buttons on vending machine should be pressed with fingers
- Easy to understand where it is possible to snap the shelf
- Hard time pressing arm mounted menu (probably by holding hand in a direction the device cannot see the finger)
- The user had an easy time manipulating the objects, although the reset on the scaling was annoying

Test person 2:

- Using arm mounted menu for manipulation is not ideal
- Did not know that you could scroll the shelf
- After remembering the controls, rotating the scene was easy
- Arm mounted menu worked good since the user already knew that he should use the finger

Test person 3:

- It was intuitive to press the arm mounted menu buttons with your finger
- Anchoring items is still hard for new users
- User thought trackpad was too sensitive
- The user did not know it was possible to scroll the shelf
- Items getting reset when you press move is annoying

Test person 4:

- User tried using the controllers' trackpad to select arm mounted buttons
- Good first impression of the arm mounted menu
- After learning the basics of the controller the user got faster on recreating the scene
- User did not know he could scroll the shelf
- The reset on the manipulation is annoying but not experience breaking

Test person 5:

- After putting the shelf down it is pretty intuitive how to get objects out of it
- The anchoring takes some time to learn
- After learning the basics, the user got faster at recreating the scene

Test person 6:

- Object snapping did not work properly (no place to put down)
- User used both hands, he is left handed

Questionnaire 2 – General thoughts

Did you understand where the menu was for?

- Yes, it was clear enough
- Big closet was clear enough that items could be grabbed out of it.
- It was logical and looked good
- Clear
- It was intuitive enough
- Easy to understand

Was it clear how to get through the menus to create a new scene?

- Buttons could be placed better
- Did not really know what I was doing with the big red square
- It was hard in the beginning
- It was easy to understand, placement was clear.
- The scrolling was a bit weird
- Needs time to get used to

What is your vision on the arm mounted menu?

- It was easy to use
- Very cool
- Logical that it should be pressed with fingers
- Felt like iron man
- Good idea
- Felt out of place, on wrong arm.

Was it easy to recreate the scene?

- Once the car was placed right, it was easy to do
- yes
- It was good, the controller is super sensitive though
- It was easy to learn
- Yes, within five minutes controls were easy.
- The buttons on the arm to front controller

Conclusion

All in all, the prototype was positively received. When being told what to do, the users could get from A to B easily.

5 out of 6 users did not notice the shelf could be scrolled.

One of the users had a hard time using the arm mounted menu, because he is left handed.

Recommendations

Make a tutorial, so people know what to do without getting told what to do.

Make the arm mounted menu for lefthanded people too.

Make signifiers for the shelf to show it is possible to scroll through.

User tests round 4 results

Introduction

In total, the test was conducted on 5 users.

First, all answers and notes will be written down, after that a conclusion will be made with recommendations.

Outcome tests

User test – Recreate the scene

Test person 1:

- Through the tutorial, the test person found the arm mounted menu without difficulty.
- Tried using the controller to select the buttons on the arm mounted menu.
- Did not know the vending machine was attached to the controller.
- The user tried swiping to navigate the context menu.
- The brush was not visible enough
- After some time, the user got comfortable with the controllers and it went faster.
- Wants copy paste.

Test person 2:

- Arm mounted menu took some time to trigger
- The user did not have any trouble putting the vending machine down and starting a new session.
- User does not know the context menu was on the controller
- User tried using his hand to interact with the context menu.
- How to change colour on the brush was not clear enough and the fact that there is a context menu for tools.
- The 2 steps to move an object was hard to master for this user.

Test person 3:

- The user found the arm mounted menu with no problems and also interacted with it at the first try.
- The user found the context menu without a problem
- The user tries to slide on the touchpad
- The brush colour change is not clear (how to use touchpad)
- The user needs more info on how to drop the tool
- After a bit the user is mostly autonomous with the task
- Context menu does not render sometimes, because the user holds it to close to the FOV

Test person 4:

- The user found the arm mounted menu with ease
- The user put the shelf down with no problem
- The user navigated through the context menu pretty quickly
- The user managed to change color easily but did not know the brush has a context menu
- After some time, the user got a lot faster and autonomous.

Test person 5:

- The user tried the controls while the tutorial was playing.
- Pressed break time during the tutorial and spawned the piano which made the user distracted.
- The user tried using the context menu with his left hand
- After learning his way through the context menu, the user got faster.
- User needs indication that there is a context menu for the brush
- The brush needs indication that it is usable.

Questionnaire 2 – General thoughts

Was the tutorial clear? What could be improved?

- It would help to have a quick overview of the inputs and learn them by doing tasks.
- In the beginning I was not focused, tutorial itself gave me good vibes.
- It was quite helpful
- Was clear,but fast.
- It was clear, helps a lot.

Was the feedback received clear? What could be improved?

- FOV is small, indicate that an item is out of the FOV.
- Sound feedback was great
- There are many different things within the application.
- Button combinations were sometimes hard
- It does help when I want to complete actions.
- Selection was clear with white prisms
- It pretty good

Was the whiteboard clear to use? Was it clear the tool on the side was usable?

- The brush was invisible, maybe highlight it.
- I automatically got the brush after placing the whiteboard.
- I had some difficulties with selecting colours
- Brush needs visual feedback
- More info on context selection.

Was it easy to replicate the scene? Context menu?

- Selecting items and have another interaction to move them is extra work
- At first I did not notice the menu, the icon for touchpad movement was hard to understand.
- It was nice to control.
- It is doable
- The movement goes really smooth when learned.

Could this be a useful tool in the future?

- Not in its current form, it is too bulky.
- It could get when optimized and shareable. It needs more intuitive ways of control.
- It helps visualizing what you want to say.
- There is potential
- It would be an added value to visualize stories or graphs during meetings.

Where there any physical or psychological strains?

- The device gets hot on the forehead.
- Empty room would optimize the test.
- Glasses itself are clunky.
- Not really.

Conclusion

The tutorial gave the testers a good introduction, but it needs to get fine tuned to really make the app self-explanatory.

The selection of a tool was not a convenient process.

The extra selection to move an object gave the user more precise control on one side, but on the other side it makes the experience more tedious, because users expect the object to move when selected.

The scrolling of the shelf is overlooked

Context menu in front of controller is better for precise manipulation.

Recommendations

Continue the tutorial on selection of a tool or at selection of object. The context menu on the controller needs to get explained.

Tools need more visual feedback when selectable.

Selecting the color on the brush needs to get clearer.

User tests round 5 results

Night of the Nerds (NotN) is an annual tech conference in Eindhoven aimed mostly at children aged 8-17. During this conference, companies like Philips, ASML and others show of technology to get children interested. Greenhouse is also a partner of NotN and this year the AR labs group got the chance to show their creations. This would be a perfect chance to test the prototype on people outside of the customer segment.

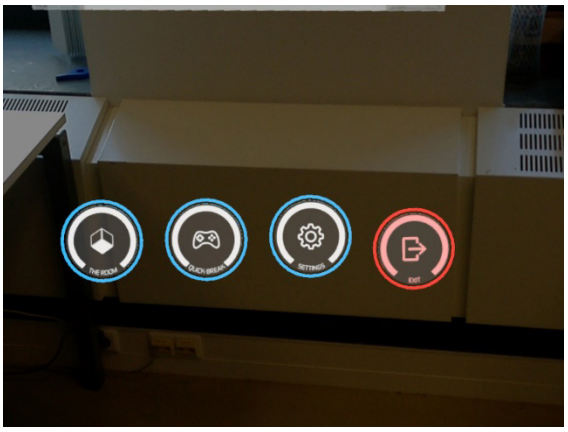
As it was a test in an uncontrolled environment, no preparations were made on how the application should be tested. The plan was to let the children just play around with the objects inside the application. This worked out well and some results included:

- Few children did know what augmented reality was.
- Children were amazed by the capabilities of the Magic Leap, a few were a bit scared by it.
- The controls were learned quickly, it took most children about a minute to understand.
- The gravity tool was used more than the brush, because its capabilities were more an added value than painting.
- In the evening, when adults tested, it became evident that they go much slower through the application and read the tooltips with information.
- The continuously changing light did not affect the Magic Leap much and even in a darker environment it was still fully usable.

In the end, the application was used about 50-60 times over the day. There were no real surprising results that came out of the tests, but it was nice to see that even people outside the customer segment liked using the app.

Results- UI placement & control

Arm mounted menus



A menu on the arm, which is controllable with the hand on the other arm, gives users a feeling that they are augmented. This kind of menu can be used as the main menu, with approximately four buttons. Too many buttons will make the menu too crowded.

Controller menus

A menu placed in front of the controller is ideal for object manipulation. A user can always see what kind of interactions are available and can keep the object being interacted with in the same FOV.

Wall mounted menus

Wall mounted menus are used best when a menu is used for a specific room or place. These menus need enough flat vertical space to put on.

Vertical floating menus

When a message needs to be shown or important tasks must be completed, a vertical floating menu is best used. For instance, a settings menu can best be placed on a vertical plane. This menu can be used everywhere, as it does not require any anchoring in the digital world.

Menus with less usability within context

Horizontal menus are hard to use. The user gets fatigued faster, because of the weight of the AR wearable. When looking down for a prolonged time, the user could experience neck strains. The usability is also mediocre at best, because hand-tracking is far from optimal. When a user wants to click on a button inside the horizontal menu, the chance is there that other buttons are clicked to. With a vertical menu, that chance is much smaller.

Menus that are anchored to an object are not usable when out of reach of the user and with the current state of hand-tracking. However, when no controller can be used, this could be the way to go when manipulating objects.

Heads up displays are too much in the FOV of current AR wearables. Also, when a user tries to look at the HUD, the HUD keeps moving out of sight, because it is anchored on the side of the FOV. However, when making an application that is just overlaying the real-life world with information without much interaction needed, a HUD could be useful.

Ways of control

Out of tests I performed every iteration I could conclude that people like using hands to manipulate objects a lot, but using the controller is more convenient. The reason behind this is that the hands must be in the FOV of the device. Because FOV of AR wearables is small, the user must have the hands in front of the wearable. This makes an experience tiring. If the FOV becomes bigger in the future, the use of hands for control will become a lot more convenient.

The supplied controller is the best option for controlling the digital environment. With its three buttons and touchpad, a lot of interactions can be done. But this controller is unique to the Magic Leap, and other AR wearables do not have a controller. For now, the controller can be seen as a way to overcome the limitations still experienced with an AR wearable.

Eye tracking needs to get optimized before it can become a viable option for controlling the digital environment. As for today, the eye tracking is not precise enough and a lot of errors can be experienced when it is used. When eye tracking becomes better in the future, it can be used for hands-free control of the environment. This would be ideal for people who must use both hands for another activity than controlling the AR wearable.

Results – physical or psychological strains on use

Most of the testers experienced no physical strains whatsoever. Eye strains were experienced by one of the testers and one got tired in the arms because of the prolonged use of hand-tracking. To really test if the user experience physical strains, the Magic Leap must be worn for a time longer than 15 minutes.

Because of the easy nature of the tasks the wearer needed to perform, no psychological strains were experienced during tests.

Conclusion

For AR wearables, the UI can be organized in a lot of different ways. From tests, more effective ways can be concluded. The use of vertical menus, wall-based menus and controller-based menus are the most effective ways. Menus that are anchored to an object could only be useful in certain use cases. Horizontal menus and HUD are not ready to be used yet in an AR wearable environment, because of the limitations an AR wearable has now.

After 5 test rounds, it can be concluded that I found an effective way of controlling the digital environment with the Magic Leap. On the Magic Leap, the supplied controller is the most optimized way of control. Eye-tracking and hand-tracking are not optimized enough to be an effective way of performing precise tasks. When these get optimized, however, they could become more intuitive ways of control than the controller.